Bend Discontinuities in Differential Signaling

Celina Gazda

Supervisor(s): Dries Vande Ginste, Hendrik Rogier

I. Problem Statement

Differential signaling is a popular way to transmit signals across printed circuit boards. To assure signal integrity, it is important to keep the differential-to-common mode noise low. Bend discontinuities [1] are a typical cause of such noise. Here, we propose an effective method to reduce the common mode noise introduced by bend discontinuities over a broad frequency range.

II. Proposed Method and Validation

To obtain good signal integrity, we propose to modify the geometry. In the area of the bend the classic lines (cross-section A) are tapered to tightly or very tightly coupled ones (cross-section B or C, respectively). This is demonstrated in Fig. 1 for a pair of coupled microstrip lines. As such, a larger difference in characteristic mode impedances is obtained, in comparison to the classic bend. The applied modifications cause higher coupling between the lines, acting as a natural common mode suppression filter.

To prove the validity of our design, time domain measurements were conducted. The input signal was a ramped differential step with a magnitude ± 1 V and a rise time $t_r = 100$ ps. It was launched by two voltage sources (each having an internal resistance of $50\,\Omega$) connected to the microstrip lines that were terminated with $50\,\Omega$ loads. As presented in Fig. 2, the common mode noise at the receiving end for the classic bend exhibits a behavior similar to the one presented in [1]. By applying our proposed solution, a large reduction of common mode noise was obtained. In case of the tightly coupled bend, the reduction in common mode noise is equal to 56 %, whereas for the very tightly coupled bend we are able to reduce it by 74 %.

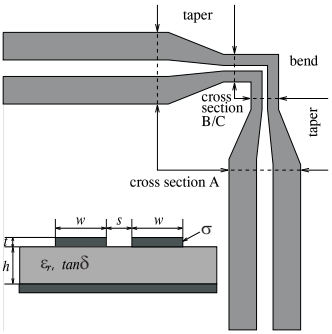

Figure 1. New layout: top view and cross-section

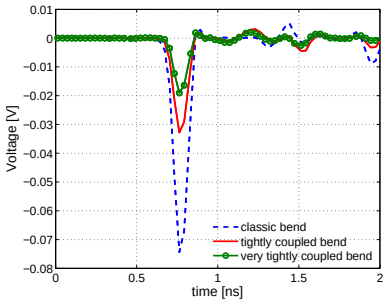

Figure 2. Measured common mode noise

References

[1] G.-H. Shiue, W.-D. Guo, C.-M. Lin, and R.-B. Wu, "Noise reduction using compensation capacitance for bend discontinuities of differential transmission lines," *IEEE Trans. on Adv. Pack.*, vol. 29, no. 3, pp. 560–569, Aug. 2006.

C. Gazda is with the Department of Information Technology, Ghent University, Belgium